

Emile-Geay, Julian, U. Southern California; Evans, Michael, U. Maryland; Noone, David, U. Colorado; Thompson, Diane, U. Arizona

Maximizing the potential of tropical climate proxies through integrated climate-proxy forward modeling

2010

Abstract: The proxy record of tropical climate over the past millennium potentially provides important validation for numerical simulations of future climate change. However, considerable uncertainty arises from the multivariate and nonlinear nature of the response of many important proxy datasets to climate forcings. This limitation is particularly acute for oxygen isotope records in fossil corals and tropical tree-ring cellulose, which constitute key archives of the variability of the El Niño - Southern Oscillation and monsoon systems, both internal oscillations with large societal impact. To maximize the utilizable information present in such proxy records, our approach rests on the 'top-to-bottom' modeling of the essential aspects of the tropical water isotope cycle, from the physics of stable isotope fractionation and transport in the atmosphere/ocean system, to the chemistry of their incorporation in coral and tree-ring archives.

We will develop process models of physical and chemical processes that realistically represent the relationships between climate variables and the oxygen isotopic composition of reef corals and tree rings. These models will be driven with the output from efficient models of the global coupled ocean-atmosphere system and the physical controls on the distribution of stable isotopes in precipitation and the surface ocean circulation. Following validation against 20th century observations, the coupled climate-isotopeproxy model will be driven by estimates of external climate forcing over the past millennium, and output compared to actual proxy observations. A fully compartmentalized error and sensitivity analysis will determine the extent to which the model system is in agreement with the observations.